

**REMARKS****Summary of the Office Action**

Claims 1-22, 33-39, and 42-45 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 14-56 of U.S. co-pending application serial number 10/507,392.

Claims 1-22, 33-39, and 42-45 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sawada (US Patent No. 6,770,544) (hereinafter "Sawada") in view of Sekiya (U.S. Patent No. 6,344,402) (hereinafter "Sekiya").

**Summary of the Response to the Office Action**

Applicants are filing a Terminal Disclaimer in response to the double patenting rejection, and have amended certain independent claims to differently define the embodiments of the present invention. Applicants respectfully submit that the claims are allowable at least for the reasons set forth below.

**The Double Patenting Rejection**

Claims 1-22, 33-39, and 42-45 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 14-56 of U.S. co-pending application serial number 10/507,392. In response, Applicants are filing a Terminal Disclaimer herewith, and respectfully request that this rejection be withdrawn.

**The 35 U.S.C. § 103(a) Rejection**

Claims 1-22, 33-39, and 42-45 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sawada (US Patent No. 6,770,544) (hereinafter "Sawada") in view of Sekiya (U.S. Patent No. 6,344,402) (hereinafter "Sekiya"). This rejection is respectfully traversed.

Applicants respectfully submit that the embodiments of the present inventions according to these claims 1, 2, 3, 33, 34 and 35 comprise dividing a semiconductor substrate together with a die-bonding resin layer attached to the semiconductor substrate by expansion of a sheet on which the semiconductor substrate is bonded by way of the die-bonding resin layer. As shown in Figs. 16A to 17B of the present application, parts of the semiconductor substrate 25 are divided together with die-bonding resin layer 23 by expansion of the sheet 21. Applicants respectfully submit that at least this feature is not taught or suggested by Sawada and Sekiya.

That is, although Sawada discloses a die-bonding resin (AD: adhesive agent) in Fig. 13, as shown in Figs. 11 and 13 of Sawada, the semiconductor wafer and the die-bonding resin are cut out by a blade (See Fig. 11). In such cutting-out of the adhesive agent (die-bonding resin) with the blade, as described in column 2, lines 44-47 of Sawada, the adhesive agent clogs the blade, making the satisfactory dicing impossible. Furthermore, Figs. 14(A), 14(B), and 14(C) of Sawada shows that a wafer may be cut-out by a laser light instead of the blade. The Examiner points out that the modified region is formed in Fig. 14(B) Sawada. However, in Sawada, as shown in Fig. 14(C), when the laser irradiation has been completed, a gap with width of W has been formed between the divided parts.

On the contrary, as shown in Fig. 16A of the present application, when the laser irradiation has been completed and the modified region 13 has been formed within the semiconductor substrate, there is no gap (as shown in Fig. 14(C) of Sawada) in the

semiconductor substrate of that embodiment of the present invention. Since the semiconductor substrate has no gap between parts to be divided, that is, the parts of semiconductor substrate to be divided contact each other, a sheet on which the semiconductor substrate is adhered with the die-bonding resin layer is expanded, and when the parts of the semiconductor substrate are divided by such expansion of the sheet, the parts of the die-bonding resin layer attached to the parts respectively are divided also at the same time.

In addition, in Sekiya, a semiconductor wafer is cut by a blade and therefore, a gap with the width of W, as shown in Fig. 14(C) of Sawada, is formed. Hence, Applicants submit neither Sawada nor Sekiya discloses nor suggests a method of dividing the semiconductor substrate without forming such a gap with the width of W between the parts of the semiconductor substrate to be divided.

Furthermore, a laser used in Sawada (See Fig. 6) is an ultra short pulse Titanium sapphire laser having a wavelength of 800 nm. The laser with the wavelength of 800 nm may be absorbed at a surface of Silicon wafer. On the contrary, the laser used in the embodiments of the present invention has a wavelength with which the laser should transmit through the semiconductor wafer (silicon wafer) because the laser used in the embodiments of the present invention should converge within the semiconductor wafer.

Accordingly, Applicants submit that in view of the above difference between the embodiments of the present invention as recited in independent claims 1, 2, 3, 33, 34 and 35 and the cited references, Applicants submit that one skilled in the art would not have found it obvious or possible to have modified Sawada in accordance with the teachings of Sekiya to have achieved the embodiments of the present invention even as recited in independent claims 1, 2, 3, 33, 34 and 35. In addition, although Applicants submit that claims 1, 2, 3, 33, 34 and 35 are

allowable over the cited references, these claims are being amended as indicated above in order to further clarify differences between the claimed embodiments and the cited references.

With regard to independent claims 19, 20, 21, 37, 38 and 39, Applicants submit that the embodiments of the present invention as recited in these claims comprise dividing a semiconductor substrate together with a die-bonding resin layer attached to the semiconductor substrate by applying a stress to the semiconductor substrate after a modified region has been formed within the semiconductor substrate, and thereafter expanding a sheet on which the semiconductor substrate is bonded by way of the die-bonding resin layer to cut the die-bonding resin layer along a cutting surface of the semiconductor substrate. As shown, for example, in Fig. 14B of the present application, a modified region 13 is formed within the semiconductor substrate 11 and thereafter, as shown in Fig. 14B, a stress is applied to the semiconductor substrate to divide the semiconductor substrate. Thereafter, die-bonding resin layer on which the semiconductor substrate is attached is cut out along which the semiconductor substrate is divided along a cutting surface 15 of the semiconductor substrate by expanding a sheet on which the semiconductor substrate is attached with the die-bonding resin layer. Applicants respectfully submit that at least these features are not taught nor suggested by Sawada and Sekiya.

That is, as discussed above, although Sawada discloses a die-bonding resin (AD: adhesive agent) in Fig. 13, as shown in Figs. 11 and 13 of Sawada, the semiconductor wafer and the die-bonding resin are cut out by a blade as shown in Fig. 11. In such cutting of the adhesive agent (die-bonding resin) with the blade, as described in column 2, lines 44-47 of Sawada, the adhesive agent clogs the blade, making the satisfactory dicing impossible. Furthermore, Figs. 14(A), 14(B), and 14(C) of Sawada shows that a wafer may be cut by a laser light instead of the blade. Also, the Examiner points out that the modified region is formed in Fig. 14(B) of the

Sawada. However, as shown in Fig. 14(C) of Sawada, when the laser irradiation has been completed, a gap with width of W has been formed between the divided parts.

Accordingly, Sawada discloses use of the blade and laser for cutting the semiconductor substrate, but in Sawada, when the semiconductor wafer has been cut and divided with such two tools, a gap with a width of W has been formed between the divided parts (chips). As shown in Fig. 14B of the present application, in division and separation of the semiconductor substrate, when the laser irradiation has been completed to form the modified region 13 within the semiconductor substrate and a stress has been applied to the semiconductor substrate to completely divide the semiconductor substrate, such a gap with the width of W, as shown in Fig. 14(C) of the Sawada, is not formed in the semiconductor substrate. Furthermore, since a sheet on which the semiconductor substrate is attached with the die-bonding resin layer is expanded under the condition that the semiconductor substrate has no gap between divided parts, and thus, the divided parts of semiconductor substrate contact each other, when a sheet on which the semiconductor substrate is adhered with the die-bonding resin layer is expanded, the die-bonding resin layer attached to the divided semiconductor substrate is cut out along a cutting surface of the divided semiconductor substrate.

On the other hand, in Sekiya, a semiconductor wafer is cut by a blade and therefore, a gap with the width of W, as shown in Fig. 14(C), of Sawada is formed. Accordingly, Sawada and Sekiya fail to teach or suggest a method of dividing die-bonding resin layer by expanding the semiconductor substrate which has been divided without forming any gap W between the divided parts.

Additionally, as discussed above, a laser used in Sawada (See Fig. 6) is an ultra short pulse Titanium sapphire laser having an 800 nm wavelength. That is, the laser with the

wavelength of 800 nm may be absorbed at a surface of Silicon wafer. On the contrary, the laser used in the embodiments of the present invention has a wavelength with which the laser should transmit through the semiconductor wafer (silicon wafer) because the laser used in the embodiments of the present invention should converge within the semiconductor wafer.

Accordingly, Applicants submit that in view of at least the above difference between the embodiments of the present invention as recited in claims 19, 20, 21, 37, 38 and 39 and the cited references, these claims should be allowable. In addition, although Applicants believe that claims 19, 20, 21, 37, 38 and 39 should be allowable over the cited references at least because these claims define cutting of die-bonding resin layer by expansion of the sheet, independent claims 19, 20, 21, 37, 38 and 39 are being amended as indicated above in order to further clarify differences between the claimed embodiments and the cited references.

With regard to independent claims 4 and 36, Applicants respectfully submit that claims 4 and 36 have no relation to die-bonding resin layer. Rather, these claims comprise forming a modified region within a semiconductor substrate to which a sheet is bonded by irradiating a laser light while locating a light converging point within the semiconductor substrate and expanding the sheet to divide the semiconductor substrate.

As discussed above, Sawada discloses as shown in Figs. 11 and 13, the semiconductor wafer is cut out by a blade (Fig. 11). Furthermore, Figs. 14(A), 14(B), and 14(C) of Sawada show that a wafer may be cut-out by a laser light instead of the blade. Also, the Examiner points out that the modified region is formed in Fig. 14(B) of Sawada. However, as shown in Fig. 14(C) of Sawada, when the laser irradiation has been completed, a gap with width of W has been formed between the divided parts.

Accordingly, Applicants submit that although Sawada discloses the use of the blade and laser for cutting the semiconductor substrate, when the semiconductor wafer has been cut and divided with such two tools in Sawada, a gap with a width of  $W$  has been formed between the divided parts (chips). Furthermore, in Sawada, to prevent the generation of particles in cutting the semiconductor substrate with the blade or laser, ultra short pulse laser is used for cutting the semiconductor substrate as shown in Fig. 6, but a gap with a width of  $W$  is formed between the divided parts of the semiconductor substrate. In addition, even if an ultra short pulse laser is used for cutting, molten which becomes damage of the semiconductor substrate or thermal harmful influence to a semiconductor devices forms on the semiconductor substrate are unavoidable.

On the contrary, in the embodiments of the present invention as recited in claims 4 and 36, such gap is not formed when the irradiation has been finished and therefore there is not such molten which becomes damage of the semiconductor substrate or thermal harmful influence to a semiconductor devices forms on the semiconductor substrate. Furthermore, since in the embodiments of claims 4 and 36 the semiconductor substrate is divided by expansion of a sheet to which the semiconductor substrate is bonded, the semiconductor substrate may be cut (divided) with clean cutting face thereof and without causing any particles.

Additionally, as discussed above, a laser used in Sawada (See Fig. 6) is an ultra short pulse Titanium sapphire laser having an 800 nm wavelength. That is, the laser with the wavelength of 800 nm may be absorbed at a surface of silicon wafer. On the contrary, the laser used in the embodiments of the present invention as recited in independent claims 4 and 36 has a wavelength with which the laser should transmit the semiconductor wafer (silicon wafer)

because the laser used in the present invention should be converged within the semiconductor wafer. Sekiya fails to make up for the deficiencies in Sawada as discussed above.

Accordingly, in view of the at least the above difference between the embodiments of the present invention recited in claims 4 and 36 and the cited references, Applicants submit that independent claims 4 and 36 should be allowable. In addition, although Applicants believe that claims 4 and 36 should be allowable, these claims are being amended as indicated above in order to further clarify differences between the claimed embodiments and the cited references.

Applicants respectfully submit that for at least the above reasons, all claims should be allowable.

### **CONCLUSION**

In view of the foregoing remarks, Applicants respectfully submit that all of the pending claims are now in prima-facie condition for allowance, and respectively request the timely allowance of the pending claims. Withdrawal of all outstanding rejections and objections is respectfully requested. Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicants' undersigned representative to expedite prosecution. A favorable action is awaited.

**EXCEPT** for issue fees payable under 37 C.F.R. § 1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 C.F.R. § 1.16 and 1.17 which may be required, including



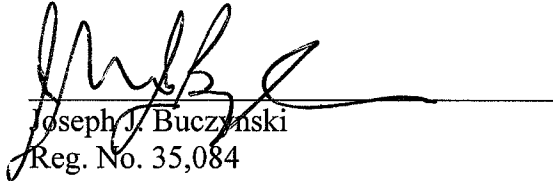
any required extension of time fees, or credit any overpayment to Deposit Account No.

50-0573. This paragraph is intended to be a **CONSTRUCTIVE PETITION FOR  
EXTENSION OF TIME** in accordance with 37 C.F.R. § 1.136(a)(3).

Respectfully submitted,

**DRINKER, BIDDLE & REATH LLP**

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Joseph J. Buczynski  
Reg. No. 35,084

**CUSTOMER NO. 55694**  
**DRINKER, BIDDLE & REATH LLP**  
1500 K Street, N.W., Suite 1100  
Washington, D.C. 20005-1209  
Tel: (202) 842-8800  
Fax: (202)-204-0289